WHITEPAPER

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A REFERENCE GUIDE TO ACOUSTIC TERMINOLOGY

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ACOUSTIC SHOCK

In this guide you will find a definition of the most used terms in acoustics when you have to do with sound and noise in telecommunications.

ITU-T (The International Telecommunication Union – Telecommunication, part of UN) and ETSI (European Telecommunications Standards Institute) define an acoustic shock as: "Any temporary or permanent disturbance of the functioning of the ear, or of the nervous system, which may be caused to the user of a telephone earphone by a sudden sharp rise in the acoustic pressure produced by it." It is difficult to determine an absolute level below which acoustic shock is not experienced. This is because an acoustic shock not only is due to the loudness of the sound, but also to the nature and unexpectedness of the sound, the frequency level, and personal characteristics. See also ACIF Guideline G616:2004.

ACIF GUIDELINE G616:2004

The AS/ACIF G616:2004 specifies a new guideline for telecommunications equipment for very strict protection against acoustic shock. According to the guideline, the maximum RMS sound pressure level of an acoustic protective device shall be less than the values specified in Table below. This is assuming any receiver volume control is set to maximum when using the test methods described by the Australian Communication Industry Forum www.acif.org.au . The column in the table shows DRP (Drum Reference Point) levels. This protects the eardrum (DRP) from levels above 102 dB RMS across all frequencies. Since higher frequencies are perceived higher by the eardrum (DRP) than the measured value outside the ear (ERP), protective equipment must control the sound level depending on its frequencies – at the ERP (Ear Reference Point) level.

FREQUENCY (HZ)	MAXIMUM RMS DB(A) SPL AT DRP (DRUM REFERENCE POINT)
410	102
516	102
649	102
818	102
972	102
1090	102
1223	102
1372	102
1540	102
1728	102
1939	102
2175	102
2441	102

DB (DECIBEL)

One decibel is one tenth of a Bel, a unit named after the inventor of the telephone, Alexander Graham Bell. A difference of 1 dB between two sound levels is the smallest difference detectable by the human ear. Decibel is a relative measure describing the ratio between two levels: 1) The level being measured, 2) A level of reference. To describe an absolute value, the level of reference must be known. For sound levels, the absolute level is referred to as dB SPL (see below).

DB SPL (SOUND PRESSURE LEVEL)

The reference for sound pressure level is the threshold of hearing for a 1 kHz tone, equal to 0 dB SPL equal to 20 µ Pascal. The decibel (dB) scale is logarithmic, meaning that an increase of 6 dB SPL actually equals twice the sound pressure.

DB(A) (A-WEIGHTING)

dB(A) or A-weighting of the decibel level is the relationship between frequency and level. dB(A) is a standard for noise measurement that takes into account the human ear's sensitivity to certain frequencies. The premise behind that at lower sounds, our ability to detect low or high frequency noise is reduced, so measurements should reflect this phenomenon. In general, we are most sensitive to sounds around 4 kHz.

DB(C) (C-WEIGHTING)

dB(C) or C-weighting of the decibel level is the relationship between frequency and level. dB(C) is a standard for noise PEAK measurement that takes into account the human ear's sensitivity to certain frequencies.

FREQUENCY (HZ)

The number of wave cycles per second – 1 kHz or 1,000 Hz is equal to 1,000 cycles per second. As we move up in frequencies, we move up in pitch, like playing the keys of a piano from the base tones on the left to the treble tones on the right. A child is able to detect sounds between 20 Hz and 20,000 Hz, but as we age, we typically lose our ability to hear the highest pitch sounds. Speech typically lies between 100 and up to 10,000 Hz. Regular landline telephony only transmits frequencies between 300 and 3,400 Hz, where most of the frequencies required for our understanding of speech lie (the so-called intelligibility). Newer VOIP systems supports wide band speech and transmit frequencies between 150 Hz and 7,000 Hz.

NOISE

EXAMPLES	SOUND PRESSURE LEVELP DBSPL
JET AIRCRAFT, 50 M AWAY	140
THRESHOLD OF PAIN	130
THRESHOLD OF DISCOMFORT	120
CHAINSAW, 1 M DISTANCE	110
DISCO, 1 M FROM SPEAKER	100
DIESEL TRUCK, 10 M AWAY	90
KERBSIDE OF BUSY ROAD, 5 M	80
VACUUM CLENER, DISTANCE 1 M	70
CONVENTIONAL SPEECH, 1 M	60
AVERAGE HOME	50
QUIET LIBRARY	40
QUIET BEDROOM AT NIGHT	30
BANCKGROUND IN TV STUDIO	20
RUSTLING LEAF	10
THRESHOLD OF HEARING	0

NOISE

In theory, noise exposure for telephone users is defined as the sum of background noise + sound signals received via the phone. In practice, the background noise in offices and contact centers does not contribute significantly to total exposure, and exposure for headset users equals the output from the headset. However, it must be recognized that background noise can make a headset user turn up the volume in order to counteract the background noise. Therefore, attention should be paid to the general sound level (noise) in the office or contact center environment. Typical noise levels from our surroundings can be seen in the table above.

PEAK VALUE (ABSOLUTE PEAK VALUE)

The absolute peak value is the maximum value of a sound coming from the receiver (speaker element).

Internationally, 140 dB is the agreed limit for absolute peak value the ear should be exposed to.

RMS VALUE

In most cases it is more relevant to look at the RMS value (Root Mean Square) of the exposure, as this is the actual energy within the signal. When the focus is excessively loud sounds, RMS value is often used instead of peak value, because the total energy of the sound waves is measured instead of their peak values. For headsets, the proposed international level for maximum RMS value is 118 dB.

LEQ LEVEL (TIME WEIGHTED AVERAGE EXPOSURE)

This term usually does not concern high peaks or acoustic shock levels. Rather, LEQ mostly relates to exposure to lower noise levels (from e.g. machines on a factory floor), which – if the exposure time is long enough – can also affect your hearing. Even "self-induced" sounds from a rock concert or a noisy disco can be harmful. These types of noises are usually A-weighted (average) and measured during an extended period of time to find the so-called time weighted average exposure or LEQ level. Time weighted average exposure is important in Noise-at-Work regulations and recommendations, where a maximum dB(A) level is measured over a working day (8 hours).

NOISE EXPOSURE REGULATIONS AND STANDARDS

According to the EU regulation, the maximum exposure value is 87 dB(A), which must never be exceeded.

In the US, the recommended time-weighted average exposure limit for an 8-hour workday is 85 dB(A). This corresponds to the upper action value in the newest EU regulation, which became mandatory in all EU member states February 2006. This regulation covers all workplaces, also contact centers where the main part of the noise exposure is through the headset.

GN Netcom is a world leader in innovative headset solutions. GN Netcom develops, manufactures and markets its products under the Jabra brand name.